

New species and new records of southwest Pacific Cancellariidae (Gastropoda)

Philippe Bouchet

Muséum National d'Histoire Naturelle
55, rue Buffon
75005 Paris, FRANCE
pbouchet@mnhn.fr

Richard E. Petit

806 St. Charles Road
North Myrtle Beach, SC 29552 USA
r.e.petit@att.net

ABSTRACT

Fifteen species of Cancellariidae referable to the genera *Zeadmete*, *Admetula*, *Fusiaphera*, *Nipponaphera*, and *Trigonostoma* are reported from depths between 200 and 700 m in New Caledonia and other island groups in the southwest Pacific. Twelve are new species: *Zeadmete bathyomom* new species, *Zeadmete physomom* new species, *Zeadmete bilix* new species, *Admetula affluens* new species, *Admetula marshalli* new species, *Admetula bathynoma* new species, *Admetula lutea* new species, *Admetula emarginata* new species, *Nipponaphera argo* new species, *Nipponaphera agastor* new species, *Nipponaphera tuba* new species, and *Trigonostoma tryblium* new species. All the Recent nominal species of *Fusiaphera* described from localities throughout the Indo-Pacific area are considered to be conspecific, the senior name being *Fusiaphera macropsira* (Adams and Reeve, 1850), now with ten synonyms. The ranges of *Nipponaphera nodosivaricosa* (Petuch, 1979) and *Trigonostoma thysthlon* Petit and Harasewych, 1987, are extended to the South Pacific.

INTRODUCTION

The present paper is a continuation of our study of the deep-water cancellariid fauna of the Southwest Pacific, based on the material originating from recent expeditions in New Caledonia, Vanuatu, Fiji, Tonga, Wallis & Futuna, and the Solomon Islands. In a previous paper (Bouchet and Petit, 2002), we described the new genus *Mirandaphera* and nine new species in the genera *Africotriton*, *Merica*, *Sveltia*, and *Nipponaphera*. We here deal with 15 species (12 new) in the genera *Zeadmete*, *Admetula*, *Fusiaphera*, and *Trigonostoma*, and add further species in *Nipponaphera*. Our review of the deep-water cancellariid fauna so far sampled in the southwest Pacific will be complete after a third paper (in preparation) dealing with the genera *Brocchinia*, *Microcancilla*, and *Gergovia*. In addition, the cancellariid fauna of New Caledonia includes shallow-water to offshore species in the genera *Scalptia* (5 species) *Tritonoharpa* (several species), as well as the rediscovered endemic *Merica semperiana*, which we intend to deal with separately.

Cancellariid radulae are not known to provide dis-

criminating species-level characters, and we thus did not attempt to systematically examine them when we had live-taken specimens available. Much of the material reported in this series was collected in the 1980–1990s and, at the time, fixed in formalin and then rinsed and dried. It is thus not adequate for nucleic-acid sequencing. More recent expeditions generate new material that is specifically put aside for barcoding. Our treatment of the cancellariid fauna is thus currently restricted to a description of the shells, including the protoconch, but we may expect that in the future it will be possible to test some of our species limits through molecular characters.

MATERIALS AND TEXT CONVENTIONS

In the lists of type and other material examined, individual lots in MNHN are unambiguously designated by the combination of cruise acronym (capitalized) and station number. DW (for Drague Warén) refers to dredge hauls, CP (for Châut à Perche) to beam trawls; lv refers to live-taken specimens, dd to empty shells; spms to individuals that cannot be unambiguously assigned to one of these two categories (essentially commercially obtained specimens). Institutional acronyms are: AMNZ: Auckland Museum, Auckland, New Zealand; BMNH: The Natural History Museum, London, UK; DMNH: Delaware Museum of Natural History, Wilmington, Delaware, USA; MNHN: Muséum National d'Histoire Naturelle, Paris, France; NM: Natal Museum, Pietermaritzburg, South Africa; NMW: National Museum of Wales, Cardiff, UK; NSMT: National Science Museum, Tokyo, Japan; USNM: National Museum of Natural History, Smithsonian Institution, Washington, DC, USA; WAM: Western Australian Museum, Perth, Australia.

SYSTEMATICS

Family Cancellariidae Forbes and Hanley, 1851

Genus *Zeadmete* Finlay, 1926

Type Species: *Cancellaria trailli* Hutton, 1873, by original designation. Recent, New Zealand.

Discussion: The genus *Zeadmete* was proposed by Finlay (1926: 429) who later (1930b: 242) considered it to be a subgenus of *Oamaruia* Finlay, 1924 from the Lower Miocene of New Zealand. Powell (1979: 224) also treated *Zeadmete* as a subgenus of *Oamaruia*. However, Garrard (1975: 44) and Wilson (1994: 173) restored *Zeadmete* as a full genus, as did Petit and Harasewych (2000: 151), who gave a brief discussion of its possible relationship to other taxa. Among other differences, the type species of *Oamaruia*, *Admete suteri* Marshall and Murdoch, 1920, has strong columellar folds whereas *Zeadmete* has weak, almost obsolete, folds.

The genus *Zeadmete*, as interpreted here, occurs in the Miocene to Recent faunas of New Zealand and in the Recent faunas of South Africa, Fiji and New Caledonia (*Z. kulanda* Garrard, from Australia, is probably an *Iphelinopsis*.) Expedition material in MNHN also contains an undescribed species from the Solomon Islands and another one from New Caledonia, both represented by specimens too imperfect to be named. All live offshore in 300–600 m, with New Zealand records as shallow as 65 meters.

Zeadmete bathyomou new species
(Figures 1–2)

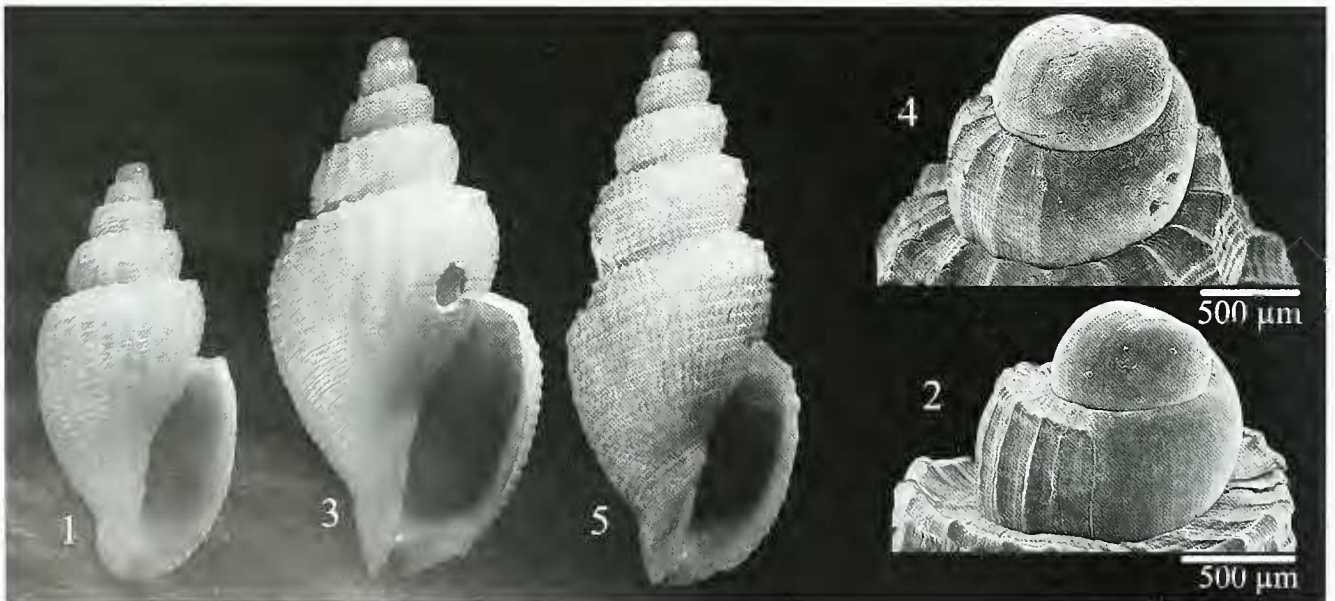
Description: Protoconch glassy, smooth, erect, of about 1.3 whorls, diameter 900 μ m. Teleoconch of four whorls. Transition to teleoconch marked by a sharp growth line and a spiral cord forming shoulder angle, shortly followed by onset of weak but sharp axial ribs, forming small nodes at strengthening shoulder angle. Additional spiral cords appear before end of first teleoconch

whorl. Shoulder angle prominent, bearing minute coronations formed by intersection of spiral cords and axial ribs. Sutural ramp strongly concave, bearing five to seven fine, low spiral cords. Suture attachment orthogonal. Shoulder raised, bearing three to five closely spaced spiral cords. About 20+ wider, low spiral cords anterior to shoulder angle, extending down onto base. Fine, low, evenly spaced axial ribs extending from shoulder angle to anterior end of shell; about 25 on last whorl; interspaces between axial ribs bearing closely packed fine growth lines. Low, narrow varices, formed only by a slight raising of shell surface, at about 120° increments on final whorls. Outer lip smooth, faintly sinuate apically, curving back in prosocline direction abapically. Aperture elongate, narrowly elliptical, without lirations inside outer lip. Parietal area with very thin, narrow callus. Columella with three folds, the posterior two weak; anterior fold broad, situated on small siphonal fasciole, forming edge of inductural callus, which then forms edge of distinct siphonal canal. Exterior beige, rims of varices pale straw-yellow.

Type Material: Holotype MNHN 20498, 10.2 \times 4.8 mm.

Type Locality: South of New Caledonia, 22°17' S, 167°12' E, 390 m [VAUBAN 1978–79: sta. 3].

Material Examined: Norfolk Ridge, south of New Caledonia.—VAUBAN 1978–79: sta. 3, 22°17' S, 167°12' E, 390 m, 1 lv (Figure 1).—BIOCAL: sta. DW77, 22°15' S, 167°15' E, 440 m, 1 dd.—BATHUS 2: sta. DW719, 22°48' S, 167°16' E, 444–445 m, 1 lv.—SMIB S: sta. DW166, 23°35' S, 167°43' E, 433–450 m,



Figures 1–5. *Zeadmete*. 1–2, *Zeadmete bathyomou* new species. 1, Holotype, height 10.2 mm; New Caledonia, Norfolk Ridge, 22°17' S, 167°12' E, 390 m [Vauban 1978–79 sta. 3]. 2, 23°35' S, 167°43' E, 433–450 m [SMIB S sta. DW166]. 3, 4, *Zeadmete physomou* new species, holotype, height 13.1 mm, Fiji, 19°01' S, 178°25' E, 500–516 m [BORDAU 1 sta. DW1488]. 5, *Zeadmete bilix* new species, holotype, height 13.2 mm; New Caledonia, Norfolk Ridge, 23°02' S, 168°16' E, 335 m [SMIB S sta. DW98].

1 dd (Figure 2); Sta. DW167, 23°38' S, 167°43' E, 430–452 m, 1 dd.—NORFOLK 1: sta. DW1666, 23°42' S, 167°44' E, 469–560 m, 2 dd.—NORFOLK 2: sta. DW2024, 23°28' S, 167°51' E, 370–371 m, 1 dd.

Etymology: From the Greek *bathus*, deep, combined with *omos*, shoulder, for the deeply concave sutural ramp. To be treated as a noun in apposition.

Distribution: Known only from south of New Caledonia, alive in 390–444 m.

Remarks: In *Zeadmete finlayi* Powell, 1940, the shoulder is also raised but the sutural ramp is not concave. In *Z. bathyomon*, the shoulder is even with, or raised above, the suture. Also, *Z. finlayi* has clathrate sculpture only on the adapical half of the last whorl, whereas the last whorl is entirely clathrate in *Z. bathyomon*. The aperture is two-thirds of the shell height in *Z. finlayi*, but in *Z. bathyomon* the aperture is just over half the shell height.

The only other *Zeadmete* species we are aware of with a sutural ramp that does not slope abapically is an undescribed species represented by two broken, worn specimens from a nearby station on the Norfolk Ridge [BERYX 11: sta. DW35, 23°33' S, 167°16' E, 550–570 m], which we leave undescribed because of the poor condition of the specimens. It differs from *Z. bathyomon* in having a shorter spire and a flatter sutural ramp that is devoid of spiral cords. It also has a larger protoconch with a diameter of 1100 µm.

Zeadmete physomon new species
(Figures 3–4)

Description: Protoconch smooth, glossy, of 1.5 whorls, diameter 1250 µm. Transition to teleoconch marked by weak axial rib and faint spiral cords, both of which increase in strength rapidly. Teleoconch of four whorls, shell thin. Spiral cords flat, evenly spaced, with interspaces slightly narrower than cords, about five on sutural ramp and 20+ anterior to shoulder angle. Axial ribs extending from suture to anterior end of teleoconch, interspaces considerably broader than ribs; about 20 ribs on last whorl. Sutural ramp slightly convex, sloping up to impressed suture. Aperture elongate-elliptical, only weakly angulate at shoulder, smooth within. Outer lip sinuous adapically but becoming prosocline anterior to periphery. Parietal wash indistinct on holotype, distinct on one paratype. Columella almost vertical, bearing three folds, posterior fold on top of siphonal fasciole. Anterior folds callused, widely separated, anterior one almost obsolete, forming edge of short siphonal canal. Exterior cream with ill-defined pale brown band on periphery of spire whorls; some ribs on last whorl have brownish tint.

Type Material: Holotype MNHN 20519 (13.1 × 6.5 mm) and 6 paratypes MNHN 20520–20521.

Type Locality: Lan Ridge, Fiji, 19°01' S, 178°25' E, 500–516 m [BORDAU 1: sta. DW1485].

Material Examined: Fiji. BORDAU 1: sta. DW1486,

19°01' S, 178°26' E, 395–540 m, 1 dd paratype MNHN 20520.—Sta. DW1488, 19°01' S, 178°25' E, 500–516 m, 6 dd, holotype MNHN 20519, paratypes MNHN 20521 (Figures 3–4).

Etymology: From the Greek *physao*, inflated, and *omos*, shoulder, for the appearance of the sutural ramp. To be treated as a noun in apposition.

Distribution: Known only from Fiji at the two stations listed above.

Remarks: Protoconch diameter in paratypes ranges from 900 to 1300 µm. *Zeadmete physomon* differs from *Z. bathyomon* in having narrower spiral cords with wider interspaces, fewer, more widely spaced axial ribs, and a slightly convex rather than strongly concave sutural ramp. Also, in *Zeadmete physomon* the axial ribs remain distinct below the periphery.

Zeadmete bilix new species
(Figure 5)

Description: Protoconch prominent, smooth, glassy, of 1.1 whorls, diameter 875 µm. Transition to teleoconch marked by onset of axial ribs and spiral cords. Teleoconch high-spired, of five whorls. Spiral cords narrow, interspaces broader than cords. About three to four fine spiral cords on sutural ramp; eight cords anterior to shoulder angle on penultimate whorl. Last whorl with about 17 narrow spiral cords, one of which forms shoulder angle and another, only slightly more prominent than those adjacent, is just posterior to periphery, giving teleoconch a weakly biconic appearance. Axial ribs fine, spaced almost equal to spacing of spiral cords, rendering teleoconch surface evenly reticulate; about 55 on last whorl. Sutural ramp narrow. Aperture narrowly elliptical. Outer lip orthocline adapically, becoming prosocline only at anterior end. Columella almost straight, bearing three folds; adapical one on siphonal fasciole, other two on a broad heavy callus; anterior one obsolete, forming edge of short siphonal canal. Periostracum pale brown, shell pale straw yellow.

Type Material: Holotype (dd) MNHN 20499 (13.2 × 5.6 mm).

Type Locality: Norfolk Ridge, south of New Caledonia, 23°02' S, 168°16' E, 335 m [SMIB 5: sta. DW98].

Material Examined: Only known from the holotype (Figure 5).

Etymology: Latin adjective *bilix*, having a double thread, with reference to the two strong spiral cords around the shoulder angle.

Distribution: Known only from New Caledonia at the type locality.

Remarks: *Zeadmete bilix* is placed in *Zeadmete* based on its columellar structure, which is identical to that of other *Zeadmete* species, but it may be immediately dis-

tinguished from its congeners by its elongate shape and relatively short aperture.

Zeadmete bilix superficially resembles the buccinid genus *Iredahula* Finlay, 1926, but species of *Iredahula* have a recurved, notched siphonal canal and lack columellar folds.

Genus *Admetula* Cossmann, 1889

Type Species: *Buccinum vulsum* Solander, 1766, by original designation. Eocene, British Isles.

Discussion: *Admetula* is often placed in the synonymy of *Bonellitia* Jousseaume, 1887 (see discussions in Sacco, 1894: 42; Cossmann, 1899: 33; Davoli, 1982: 62; Verhecken, 1986: 33; but not Verhecken 2007: 286), but we regard *Bonellitia* as distinct, based on the angled whorls and muricated sculpture. We refer to Landau, Petit, and Marquet (2006) for further discussion. The genus *Admetula* is well represented in Paleogene and Neogene Tethyan faunas and in the Recent fauna along continental margins at depths ranging from 75–700 m (Petit and Harasewych, 1991: 181).

Many species of *Admetula* appear superficially very similar, especially based on published illustrations, yet can easily be distinguished when directly compared. Three discrete “subgroups” can be recognized in the genus. One consists of small attenuate species such as *A. cornidei* (Altamira, 1978), *A. epula* Petit and Harasewych, 1991, and *A. afra* Petit and Harasewych, 2000. Larger, wide, rather thin-shelled species such as *A. bayeri* Petit, 1976, and *A. emarginata* (described herein) form a second group, with a third, intermediate group composed of thick shells with an anterior constriction of the last whorl such as *A. vossi* Petit, 1976, and *A. deroyae* (Petit, 1970). Early Tertiary species usually have well-formed varices at irregular intervals, a feature not found on Recent species.

Admetula affluens new species
(Figures 6–8)

Description: Protoconch corroded on holotype, in other specimens consisting of 0.5 whorls, diameter 775 μm , shiny, smooth apically, with six raised threads on abapical part. Transition to teleoconch distinct, marked by onset of teleoconch sculpture. Teleoconch spire high, spire angle 47°; teleoconch consisting of 6.25 whorls, with sculpture of evenly spaced, narrow axial ribs crossed by spiral cords forming small nodes at intersections. About 15 axial ribs on penultimate whorl, about 18 on last whorl. About 12 primary spiral cords on last whorl, with spacing equal to that of axial ribs on shoulder and periphery; more crowded on base; four to seven secondary spiral cords in each interspace. Outer lip sharp, prosocline. Aperture without lirations. Parietal area with very thinly applied callus. Columella sloping, bearing two prominent folds extending to edge of inductural callus, with a third broad siphonal fold. Siphonal canal shallow, well defined. Exterior white with thick, pale olive-brown periostracum.

Type Material: Holotype MNHN 20500 (22.7 \times 13.0 mm) and 4 paratypes MNHN 20501–20502.

Type Locality: SW of Malaita, Solomon Islands, 09°46' S, 160°53' E, 611–636 m [SALOMON I: sta. CP1808].

Material Examined: Solomon Islands. SOLOMON I: sta. CP1749, 09°21' S, 159°56' E, 582–594 m, 1 dd.—Sta. CP1750, 09°16' S, 159°55' E, 693–696 m, 1 dd.—Sta. CP1751, 09°10' S, 159°53' E, 749–799 m, 2 lv (1 paratype MNHN 20501).—Sta. CP1793, 09°13' S, 160°08' E, 505–510 m, 1 dd, 1 juv. dd (Figure 8).—Sta. CP1798, 09°21' S, 160°29' E, 513–564 m, 2 lv, 1 dd.—Sta. CP1808, 09°46' S, 160°53' E, 611–636 m, 1 lv (holotype, Figures 6–7).—Sta. CP1859, 09°33' S, 160°37' E, 283–305 m, 1 lv, 2 dd (3 paratypes MNHN 20502). Total of 13 specimens. (Largest specimen: 26.3 \times 15.6 mm.)

Distribution: Known only from the Solomon Islands, alive in 305–749 m.

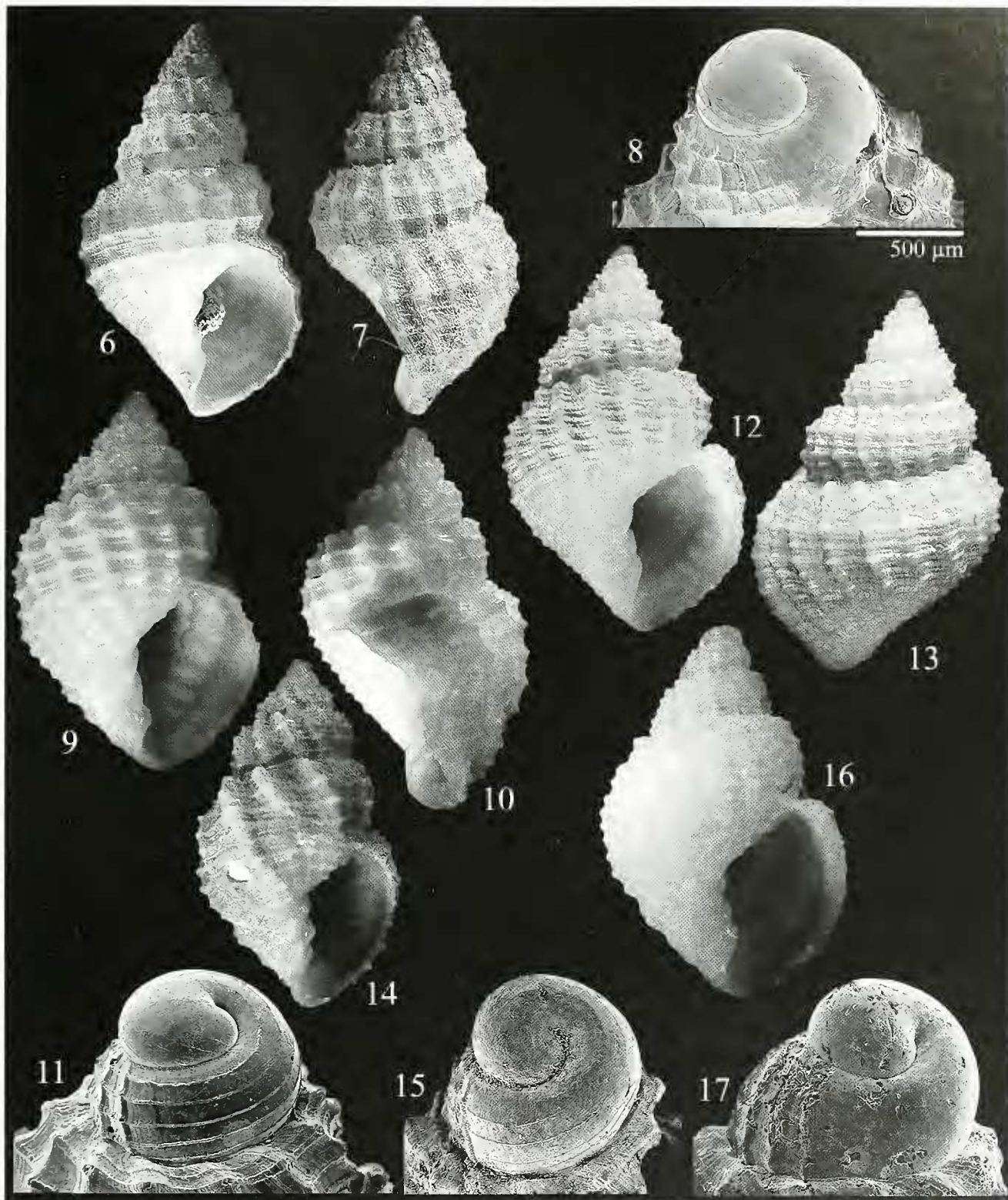
Etymology: From the Latin *affluens*, an adjective meaning abundant or copious, with reference both to its large size and relative abundance in the Solomon Archipelago.

Remarks: *Admetula affluens* superficially resembles the specimen figured as *A. garrardi* (Petit, 1974) by Hasegawa (2000: 585, pl. 291, figure 26) but differs by having narrower axial ribs, a more constricted base and a more twisted columella. It lacks the lirations within the outer lip that are present in *A. garrardi*. It is our opinion that the specimens figured as *A. garrardi* by Hasegawa (2000) and Verhecken (1997: 300, figs. 11–13) are not that species. Verhecken (1986: 34–35, figs. 1–2) examined, redescribed and figured the holotype of *A. garrardi* and explicitly described its multispiral protoconch whereas *A. affluens* has a paucispiral protoconch.

Of the other species of *Admetula* in the tropical southwest Pacific, *A. affluens* is more similar to *A. marshalli*, but differs by its larger adult size, less solid shell, much weaker spiral cords and lack of apertural lirations.

Admetula emarginata new species
(Figures 9–11)

Description: Protoconch glossy, white, of 1.1 whorls, diameter 1000 μm , with five widely spaced spiral cords. Transition to teleoconch indistinct, protoconch cords continuing as teleoconch cords. Teleoconch of five whorls, suture impressed, with sculpture of numerous prominent, well-defined axial ribs crossed by spiral cords forming small nodes at intersections. About 14 widely spaced axial ribs on penultimate whorl and about 12 on last whorl, final one enlarged into terminal varix. About eight primary spiral cords on last whorl, more closely spaced than axial ribs, with one or more secondary spirals in each interspace and about six prominent secondary spiral cords on spire whorls below rounded shoulder angle. Shell thin, axial ribs visible through last whorl.



Figures 6–17. *Admetula*. **6–8.** *Admetula affluens* new species. **6–7.** Holotype, height 22.7 mm. Solomon Islands, 09°46S, 160°53' E. 611–636 m. [SALOMON 1 sta. CP1808]. **8.** Protoconch, Solomon Islands, 09°13' S, 160°05' E. 505–510 m. [SALOMON 1 sta. CP1793]. **9–11.** *Admetula emarginata* new species. **9–10.** Holotype, height 16 mm, Coral Sea, 20°03' S, 158°45' E, 315 m [MUSORSTOM 5 sta. 335]. **11.** Protoconch, Coral Sea, 19°33.5' S, 158°30.5' E, 230 m [CORAIL 2 sta. D31]. **12–13.** *Admetula marshalli* new species, holotype, height 14.7 mm. Fiji, 16°39' S, 179°57' W, 591–596 m [BORDAU 1 sta. CP1396]. **14–15.** *Admetula lutea* new species. **14.** holotype, height 13.1 mm, Tonga, 21°19' S, 175°01' W, 225–233 m [BORDAU 2 sta. DW1521]. **15.** Protoconch, Fiji, 15°09' S, 175°39' W, 290–300 m [BORDAU 1 sta. DW1465]. **16–17.** *Admetula bathynoma* new species. **16.** Holotype, height 7.4 mm, New Caledonia, 22°52' S, 167°23' E, 590–600 m [MUSORSTOM 4 sta. DW225]. **17.** Protoconch, New Caledonia, 22°52' S, 167°16' E, 530–541 m [BATHUS 2 sta. DW720]. All protoconchs at the same scale, scale bar 500 μ m.

Outer lip prosocline, sinuous, with everted stromboid notch just anterior to periphery and another everted notch near base. Aperture with nine lirations, visible internally at level of terminal varix, not extending to edge of lip or deeply into aperture. Parietal area with very thinly applied callus. Columella sloping, with two prominent folds extending to edge of inductural callus and a third broad siphonal fold. Siphonal canal shallow, well defined. Shell white, with weakly defined bands of pale brown at shoulder and base, also brown behind outer lip.

Type Material: Holotype MNHN 20503 (16.0 × 10.9 mm) and one paratype MNHN 20504.

Type Locality: Coral Sea, 20°03' S, 158°45' E, 315 m [MUSORSTOM 5: sta. 335].

Material Examined: Coral Sea. CHALCAL: sta. D31, 19°33.5' S, 158°30.5' E, 230 m, 1 dd (paratype, Figure 11).—MUSORSTOM 5: sta. 335, 20°03' S, 158°45' E, 315 m, 1 dd (holotype, Figure 9–10).—EBISCO: sta. CP2571, 20°25' S, 158°45' E, 298–309 m, 1 dd.

Etymology: From the Latin *emarginatus* after the sinuous, everted outer lip.

Distribution: Known only from the Coral Sea near the Chesterfield Islands, empty shells in 230–315 m.

Remarks: *Admetula emarginata* differs from other described species of *Admetula* in having diffused coloration. It is much like *A. bayeri* Petit, 1976, from the western Gulf of Mexico in having at the periphery a notch, which is not present in the similar species *A. bathynoma*. *Admetula emarginata* also differs from *A. bathynoma* in having less closely spaced spiral cords and axial ribs. The overall effect of the sculpture on *A. emarginata* is a striking pattern of horizontal rectangles crossed by fine spirals.

Admetula marshalli new species
(Figures 12–13)

Description: Protoconch glossy, brown, of one whorl, diameter 825 μm, with three widely spaced spiral cords. Transition to teleoconch marked by a change in color and onset of axial ribs. Teleoconch of 5.5 whorls. Suture impressed. Spiral cords closely spaced, about 14 primary cords on last whorl with one secondary cord in most interspaces, forming small pointed beads where they cross axial ribs. One spiral cord creates a modest angle between periphery and narrowly rounded shoulder. About 14 rounded axial ribs on last whorl, only final one enlarged into a varix. Fine, densely packed growth lines on entire teleoconch. Outer lip thin, very indistinctly notched just anterior to periphery and with a slight eversion of the siphonal canal. Aperture with nine lirations, visible interior to terminal varix but not extending deeply within aperture or to outer lip. Parietal area with thin but distinct callus. Columella concave, bearing three distinct folds that extend out to edge of inductural callus. Posterior fold largest, separated from central fold by a deep depression; two anterior folds form a shelf bordering

short, broad siphonal canal. Shell white, periostracum yellow-brown.

Type Material: Holotype MNHN 20505 (14.7 × 9.0 mm) and 2 paratypes (all dd) MNHN 20506 (largest paratype: 17.0 × 9.7 mm).

Type Locality: Fiji, Lau Ridge, 16°39' S, 179°57' W, 591–596 m, [BORDAU 1: sta. CPI396].

Material Examined: Only known from the type material.

Distribution: Known only from the Lau Ridge in Fiji, empty shells in 591–596 m.

Etymology: Named after Bruce Marshall (Museum of New Zealand, Wellington), in appreciation for the standards of his descriptions and illustrations of the molluscan fauna of New Zealand.

Remarks: The New Zealand species *A. superstes* (Finlay, 1930b) is similar in shape and size, but differs in having a translucent white rather than brown protoconch with numerous fine, close spiral threads (versus 3 widely spaced cords), in having weaker axial costae on the teleoconch, in lacking a terminal varix and internal lirations behind the apertural rim at maturity, and in that secondary spiral sculpture is considerably weaker or entirely absent. Additionally, *A. superstes* has a much more strongly developed periostracum, with prominent spines at the summits of the axial lamellae. *Admetula superstes* is endemic to northern New Zealand, living on muddy substrata in 79–550 m off the northeastern (northernmost record at 35°08' S) and southwestern North Island. A similar species (possibly a local variant) occurs off Three Kings Islands. There is no material of similar species from Norfolk Ridge south of Norfolk Island in NMNZ.

Admetula lutea new species
(Figures 14–15)

Description: Protoconch glassy, of slightly more than one whorl, diameter 975 μm, worn but with traces of spiral cords visible on terminal portion. Transition to teleoconch rather indistinct. Teleoconch of about 4.7 whorls. Whorl profile regularly convex; suture impressed. Sculpture of prominent prosocline axial ribs crossed by weaker spiral cords; about nine to ten axial ribs on last whorl, eleven on penultimate whorl, some forming irregularly placed varices; four primary spiral cords on penultimate whorl and about 12 on last whorl, with one to four secondary spirals in each interspace; spiral cords forming elongate nodes where they cross axial ribs. Outer lip with very indistinct lirations, visible internally at level of terminal varix, not extending either to edge of lip or deeply within aperture. Parietal area with thin callus. Inductura almost vertical. Columella bearing three folds; narrow anterior fold forming edge of short, recurved siphonal canal. Exterior yellow-brown. Periostracum thin, with low incremental lamellae and hairy projections on spiral cords.

Type Material: Holotype MNHN 20507 (13.1 × 7.8 mm) and one paratype MNHN 20508.

Type Locality: Tonga, 21°19' S, 175°01' W, 225–233 m [BORDAU 2: sta. DW1521].

Material Examined: Fiji. BORDAU 1: sta. DW1465, 18°09' S, 178°39' W, 290–300 m, 2 dd.—Tonga. BORDAU 2: sta. DW 1521, 21°19' S, 175°01' W, 225–233 m, 1 dd (holotype, Figure 14).—Sta. CP1576, 19°42' S, 174°15' W, 253–263 m, 1 dd (paratype, Figure 15).

Etymology: From the Latin adjective *luteus*, meaning yellow, in reference to the color of the shell.

Distribution: Known only from Fiji and Tonga at localities cited above.

Remarks: This new species differs from its congeners by its strongly prosocline axial ribs forming irregularly placed varices and its spiral sculpture with numerous secondary cords. It is also distinguished from other *Admetula* species by its yellow color.

A specimen of *Admetula lutea* new species in the Petit collection (No. 2872) is said to be from 50–200 m north of Taiwan, but this is a dealer's locality designation that needs to be confirmed.

Admetula bathynoma new species
(Figures 16–17)

Description: Protoconch glassy, white, smooth, of one whorl, diameter 975 μm. Transition to teleoconch marked by onset of axial ribs and spiral cords. Teleoconch of about four whorls. Last whorl bearing about ten to 14 rounded axial ribs, crossed by prominent spiral cords, about five to six cords on spire whorls and about ten on last whorl, with fine secondary spirals in the interspaces. Final axial rib enlarged into a varix. Small nodes formed at intersections where spiral cords cross axial ribs. Sutural ramp narrow, almost flat; suture slightly impressed. Outer lip prosocline, rounded, smooth, without lirations within. Parietal area without wash or callus. Columella slightly inclined, bearing two prominent folds extending out to edge of inductural callus; a third descending fold forming edge of short siphonal canal. No siphonal fasciole. Last whorl well rounded. Shell white.

Type material: Holotype MNHN 20509 (7.4 × 5.0 mm) and one paratype MNHN 20510.

Type locality: Norfolk Ridge, south of New Caledonia, 22°52' S, 167°23' E, 590–600 m [MUSORSTOM 4: sta. DW225].

Material examined: Norfolk Ridge. BIOCAL: sta. DW46, 22°53' S, 167°17' E, 570–610 m, 1 dd (paratype).—MUSORSTOM 4: sta. DW225, 22°52' S, 167°23' E, 590–600 m, 1 lv (holotype, Figure 16).—SMIB S: sta. DW193-196, 22°59'–23°00' S, 168°21'–168°23' E, 491–555 m, 1 juv. dd.—BATHUS 2: sta. DW720, 22°52' S, 167°16' E, 530–541 m, 1 juv. dd (Figure 17).

Distribution: Known only from the Norfolk Ridge, in 491–610 m.

Etymology: From the Greek *bathus*, deep, and *nomos*, place of living, treated as an adjective.

Remarks: *Admetula bathynoma* resembles a juvenile *A. marshalli* but differs by being proportionally narrower, with less convex whorls and a larger protoconch (diameter 975–1000 μm versus 825 μm in *A. marshalli*). *Admetula marshalli* also differs in having pointed beads rather than small nodes formed at the intersections of the axial ribs and spiral cords.

Kolm and Aria (1999: pl. 13, fig. 55) illustrated as *C. atopodonta* Petit and Harasewych, 1986 an 8 mm high specimen of *Admetula* from the Early Pleistocene of Viti Levu, Fiji. Their specimen closely resembles the present species except that the Fiji fossil has lirations within the aperture.

Genus *Fusiaphera* Habe, 1961

Type Species: *Cancellaria macrospira* Adams and Reeve, 1850, fixed herein to comply with ICZN Article 70.3. Recent, Japan.

Discussion: Habe (1961a) proposed the genus *Fusiaphera* for a species he identified as *Cancellaria macrospira* Adams and Reeve. Later in the same year, he (Habe 1961b) considered the species he had identified as *C. macrospira* to be a different species, which he then named *Fusiaphera macrospiratoides* Habe, 1961. The fact that the type species of *Fusiaphera* was based on a misidentified type species was noted by Verhecken (1986: 35), who stated that there is some confusion in the matter of the type species but did not make a definitive statement about the resolution of the problem. He did list, however, *Fusiaphera macrospira* (Adams and Reeve) as type species, as did Beu and Maxwell (1987: 55), who then stated “but misidentified?, ?really = *Fusiaphera macrospiratoides* Habe, 1961.” The confusion is demonstrated by the fact that Matsukuma, Okutani and Habe (1991: 179, pl. 111, fig. 2) figured the type specimen of *F. macrospiratoides* under the name *F. macrospira*. In the absence of a definitive statement by Verhecken and the queries used by Beu and Maxwell, it appears to be necessary to fix a type species to comply with Article 70.3. *Cancellaria macrospira* Adams and Reeve is here selected as the type species of *Fusiaphera* Habe, 1961.

Fusiaphera is distinguished by a slender, non-umbilicate teleoconch with irregular varices and a thick outer lip with a well-defined posterior canal under the shoulder. The aperture is much like that of *Scalptia* but with a straighter columella. The genus *Fusiaphera* ranges from South Africa across the Indian Ocean, north to Japan, to Australia, New Caledonia and Fiji. It thus appears to be restricted to the Indo-Pacific area with the earliest known occurrence in the Miocene of Australia. Darragh (1970: 168) referred the Australian Miocene species *Cancellaria epidromiformis* Tate, 1889 and *C. exaltata* Tate, 1889, to *Fusiaphera*, a placement accepted

by Maxwell (1992: 166). However, three New Zealand Eocene species, *Uxia* (?) *marshalli* Allan, 1926, *Uxia naroniformis* Finlay, 1930, and *Fusiaphera jenkinsi* Maxwell, 1992, placed in *Fusiaphera* by Beu and Maxwell (1990) and Maxwell (1992), are not considered by us to be correctly placed. Also, *Plesiotriton paytensis* Olsson, 1930, from the Eocene of Peru, was tentatively placed in *Fusiaphera* by Beu and Maxwell (1987: 55) but it is here excluded from the genus. It is possible that a new genus will have to be erected to contain these Eocene taxa. Many European Tertiary species of *Unitas* resemble *Fusiaphera* in form but they lack a strongly delineated posterior canal.

Fusiaphera macrospira (Adams and Reeve, 1850)
(Figures 18–25)

Cancellaria macrospira Adams and Reeve, 1850: 41, pl. 10, fig. 2.

Cancellaria wilmeri G. B. Sowerby II, 1881: 637, pl. 56, fig. 2.

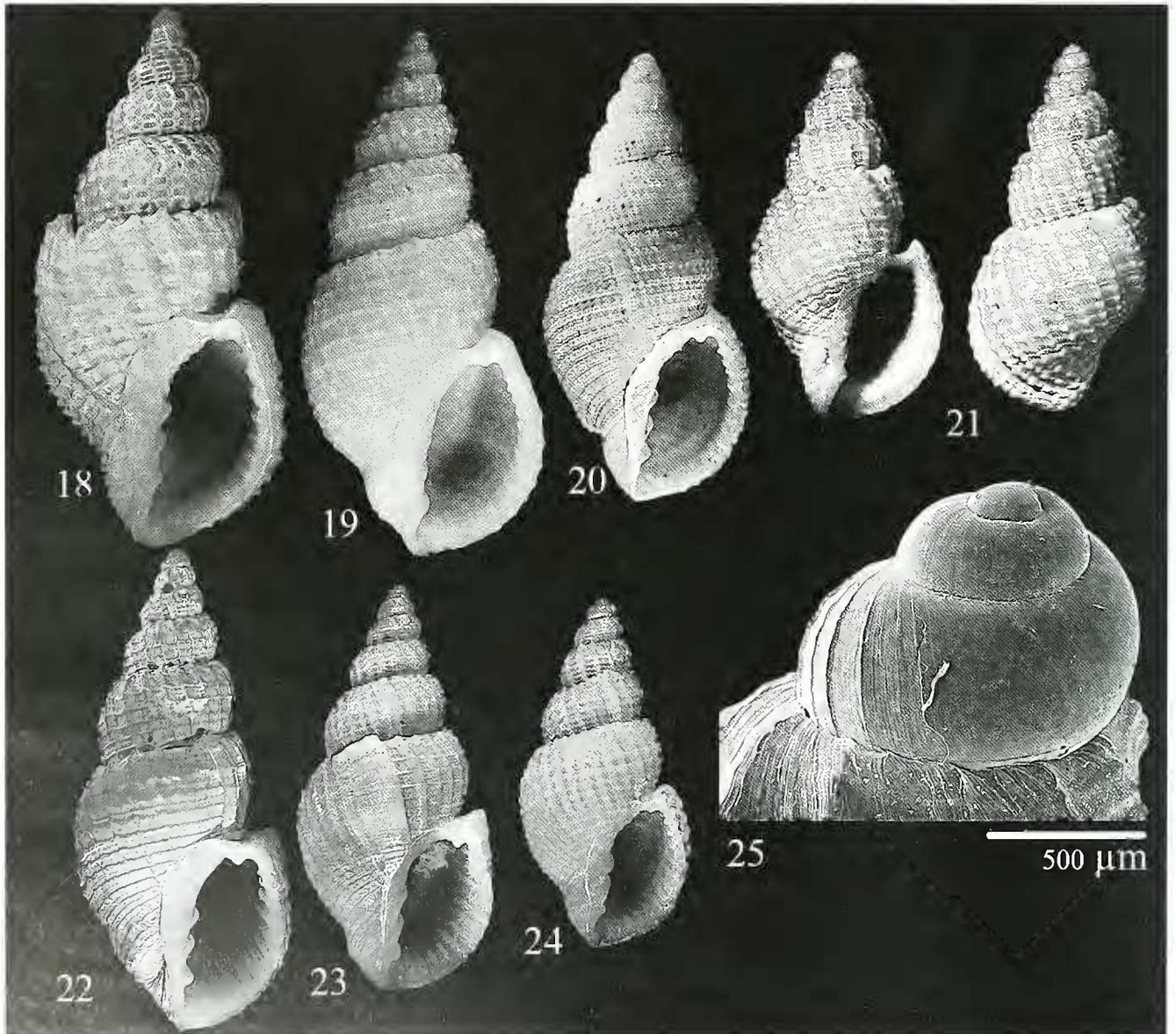
Cancellaria pallida E. A. Smith, 1899: 313, text-fig. 4.

Cancellaria producta G. B. Sowerby III, 1903: 220, pl. 4, fig. 5.

Cancellaria (*Trigonostoma*) *luscini* Melvill and Standen, 1903: 319, pl. 23, figs. 14–15.

Cancellaria exquisita Preston, 1905: 3, pl. I, fig. 9.

Cancellaria tosaensis Habe, 1961a: 72, Appendix 28, pl. 35, fig. 21.



Figures 18–25. *Fusiaphera macrospira* (Adams and Reeve, 1850). 18. Height 20.2 mm, Philippines, Balicasag I., said to be from 130–230 m. 19. Height 30.1 mm, Japan, Mikawa. 20. *macrospiratoides* form, height 16.2 mm, Mikawa Issiki, Japan. 21. Holotype of *Cancellaria wilmeri* (BMNH 1881.5.20.30), height 11.8 mm. 22. *tosaensis* form, height 20.4 mm, Minabe, Japan. 23. Height 15.0 mm, New Caledonia, 19°35' S, 163°25' E, 48 m [LAGON sta. 1192]. 24, 25. Height 11.0 mm, New Caledonia, 19°06' S, 163°10' E, 50 m [LAGON sta. 542].

Cancellaria azumai Habe, 1961a: 72, Appendix 2S, pl. 35, fig. 20.

Cancellaria macrospiratoides Habe, 1961b: 433, pl. 23, fig. 10, pl. 24, fig. 10.

Fusiaphera dampierensis Garrard, 1975: 17, pl. 2, fig. 8.

Fusiaphera eva Petit, 1980: 215, figs. 5, 6.

Type Data: *F. macrospira*, China Sea, BMNH 1969347, lectotype designated by Verhecken (1986: 36); illustrated by Higo, Callomon and Goto (2001: 99).

C. wilmeri, Port Blair, Andaman Islands, holotype BMNH 1881.5.20.30, herein Fig. 21.

C. pallida, 25 fms, off Bonaparte Archipelago, NW Australia, holotype BMNH 1891.11.21.96.

C. producta, 40 fms, off mouth of Umhloti River, Natal, syntypes BMNH 1903.7.27.76; SAM-A339 (Giles and Gosliner, 1983: 2S).

C. (T.) luscinia, 40 fms, Arabian Sea, 18°58' N, 71°45' E, syntypes BMNH 1903.12.15.101–102 (2 syntypes); NMW 1955.158.408.

C. exquisita, Ceylon, holotype BMNH 1905.10.4.75.

C. tosaensis, Kochi Prefecture, Shikoku, Japan, holotype NSMT-Mo 13287; illustrated by Higo, Callomon and Goto (2001: 99).

C. macrospiratoides, Aiki Prefecture, Honshu, Japan, holotype NSMT-Mo 39781; illustrated by Higo, Callomon and Goto (2001: 99).

C. azumai, Aiki Prefecture, Honshu, Japan, NSMT-Mo 13285a (illustrated by Higo, Callomon and Goto 2001: 99) is labeled as type in NSMT but is not the figured specimen and is smaller than dimensions given for holotype.

F. dampierensis, Delambre Island, Dampier Archipelago, northwestern Australia, holotype WAM 550-71.

F. eva, west of central Bazaruto Island, southern Mozambique, holotype NM G-4896.

Description: Protoconch smooth, glassy, of two whorls with small initial nucleus, diameter 1000–1125 μm , indicating planktotrophic larval development. Transition to teleoconch marked by sharp axial rib followed by additional ribs and cords. Teleoconch slender, of about 6 whorls. Axial ribs variable in number, 15 to 20 on last whorl of most specimens, extending adapically over slightly channeled sutural ramp to suture. Some ribs forming varices at irregular intervals, others projecting slightly above ramp. Spiral sculpture of fine cords, about 15 on last whorl of most specimens, with weaker secondary cords in most interspaces. Cords form small nodules where they intersect axial ribs. Aperture narrowly ovate. Outer lip thickened into a varix, with about 14–16 strong lirae that do not descend deeply into aperture. Internal liration beneath sutural ramp forms edge of well-defined posterior canal. Parietal shield thin but well developed, with pustules on its outer edge. Columella with three folds, anterior one forming edge of short siphonal canal. Last whorl slightly constricted at base behind weak siphonal fasciole. Exterior brown or white. Many brown specimens with a weak band of white just below periphery and white on the adapical ends of ribs and projections extending above the shoulder.

Material Examined: Japan. Off Mikawa, 30 fms, 1 spm (figured by Abbott and Dance, 1982).—Mikawa Is-

siki, Aichi Pref., 50–70 m, 1 spm (Figure 20).—Off Minabe, Wakayama Pref., 80–100 m, 2 spms (Figure 22).—Off Minabe, 100–200 m, 1 spm.—Off Mikawa, 50 fms, 1 spm (Figure 19).—Off Tosa, 50 fms, 1 spm.—“Japan”, 1 spm.—“Japan?”, 1 spm (gift from Habe with “*azumai*” in his hand).—Mikawa Bay, 50 m, 1 spm.—Off Mikawa, 40 fms, 1 spm.—Enshu Kei, 2 spms. East China Sea. “180 m”, 1 spm. Taiwan. Off Keelung, 50–110 m, 2 spms.—Off Keelung, 100–200 m, 5 spms.—Off SW Taiwan, 1 spm.—Off Keelung, “deep water”, 1 spm.—Off SW Taiwan, 60 fms, 1 spm. Philippines. Off Aliguay Island, Mindanao, “240 m”, 2 spms.—Off Aliguay Island, “80–120 m”, 1 spm.—Off Balicasag Island, “240 m”, 1 spm.—Off Balicasag, “130–230 m”, 1 spm (Figure 18).—MUSORSTOM 3: sta. DR140, 11°43' N, 122°34' E, 93–99 m, 1 dd; Sta. CP 141, 11°45' N, 122°45' E, 40–44 m, 1 dd. Vietnam. no locality, “50 m”, 1 spm. Indonesia. Masalembu, Java, ca. 20 fms, 1 spm. (All above in Petit collection). Solomons. SOLOMON 1: sta. DW1760, 8°47' S, 160°01' E, 172–179 m, 1 dd. Coral Sea. CHALCAL sta. D11, 20°31' S, 161°06' E, 83 m, 1 dd. New Caledonia. LAGON: sta. 375, 22°32' S, 167°08' E, 67–71 m, 1 dd; Sta. 517, 19°09' S, 163°35' E, 42 m, 2 dd; Sta. 542, 10°06' S, 163°10' E, 50 m, 3 lv (Figures 24–25); Sta. 1129, 19°29' S, 163°49' E, 40m, 3 lv, 2 dd; Sta. 1163, 19°11' S, 163°22' E, 48m, 2 dd; Sta. 116S, 19°16' S, 163°09' E, 50 m, 1 lv; Sta. 1192, 19°35' S, 163°25' E, 48m, 1 lv, 1 dd (Figure 23).—MUSORSTOM 4: sta. DW151, 19°07' S, 163°22' E, 200 m, 1 dd. Fiji. SUVA2: sta. DW44, Viti Levu, 17°51.7' S, 177°13' E, 33 m, 1 dd.

Dimensions: 19.3 \times 8.4 mm (Coral Sea, CHALCAL sta. D11), 17.9 \times 8.3 mm (New Caledonia, LAGON sta. 1192), 14.8 \times 7.3 (New Caledonia, LAGON sta. 1192), 30.2 \times 14.0 mm (Japan).

Distribution: Natal, Mozambique, Arabian Sea, Angrias Bank, India, Ceylon, Andaman Islands, northwest Australia, Japan (from Izu Peninsula and Yamaguchi Pref. southwards), Taiwan, the Philippines, Vietnam, Indonesia, Solomon Islands, Queensland, Australia, New Caledonia and Fiji. Offshore from 20 to ca. 250 m.

Remarks: Of the eleven nominal species that we include under *Fusiaphera macrospira*, two have type localities in the southwest Indian Ocean, one in the Arabian Sea, two in the Bay of Bengal, two off northwestern Australia, one off Borneo and three off Japan. We have examined representative material from Japan, Taiwan, the Philippines and New Caledonia and fail to recognize more than one species. All specimens have in common a naticoid multispiral protoconch indicating planktotrophic development and we interpret the different names as individual rather than geographical variants, connected by intermediates. Of these, the nominal species *F. macrospiratoides* represents a form where the axial and spiral sculpture are of equal prominence, whereas *F. tosaensis* represents a form with much stronger axial sculpture. Hasegawa (2000: 585) was of the same opinion when he

stated that "[*F. macrospiratoides*] and other related species, such as *F. azumai* Habe, 1961 and *F. tosaensis* Habe, 1961 may be intraspecific forms of *F. macrospira* (Adams and Reeve, 1850)." We did not examine extensive material from the Indian Ocean but published descriptions and illustrations suggest that the nominal species from this area also fall within the range of variation of *F. macrospira*. Specimens from northwestern Australia described by Garrard (1975: 17–19) are, however, distinctly smaller with average heights of 10.5 mm to 14 mm.

Genus *Nipponaphera* Habe, 1961

Type species: *Nipponaphera habei* Petit, 1972 by ICZN Opinion 1052; Recent, Japan.

Discussion: Species of *Nipponaphera* have the angled outline of *Trigonostoma* but are less tabulate, have only a small umbilicus if one is present, and have a different columellar morphology. The genus has been utilized primarily to include species having an angled last whorl, a triangular aperture, and three columellar folds. Here we also place in *Nipponaphera* species with a rounded last whorl and rounded aperture, but which are united with those taxa traditionally included in the genus by the peculiar columellar morphology consisting of two anterior columellar folds situated on a slightly raised shelf, much like a widely bifurcate single fold.

The genus *Misteia* Janssen, 1954, from the Miocene of The Netherlands, is similar in outline to the angled species of *Nipponaphera*, but has only two weak folds on the columella.

Axelella Petit, 1988 (a replacement name for the preoccupied *Olssonella* Petit, 1970) has been considered to be confined to the Americas (Petit, 1970: 84; 1972: 104). What appears to be a neat division of genera between the Americas (*Axelella*) and the Indo-Pacific (*Nipponaphera*) is blurred by the enigmatic species *Cancellaria agalma* Melville and Standen, 1901, from the Gulf of Oman, a species that appears to possess the characters of *Axelella*. Despite that species, which has not been studied in detail, it is our opinion that the similarities between *Axelella* and *Nipponaphera* are superficial and that they can be separated by their columellar morphology.

Recent species of *Nipponaphera* have previously been known from South Africa to the northwestern Indian Ocean, eastward to the Philippines and north to Japan. The range is now extended to New Caledonia. In addition to the species treated by Bouchet and Petit (2002), we now include in *Nipponaphera* the following: *N. semipellucida* (Adams and Reeve, 1850) [described in *Cancellaria*; previously placed in *Cancellaria* by Habe (1961b) and other Japanese authors]; *N. teramachii* (Habe, 1961) [described in *Trigonaphera*, placed in *Scalptia* and *Trigonostoma* by various authors; placed in *Nipponaphera* by Habe (1961a: pl. 36, fig. 4) on the plate caption although in the text it is placed in *Trigonaphera*]; *N. nodosivaricosa* (Petuch, 1979) [described in *Agatrix* (*Olssonella*), placed in *Nipponaphera* by Bouchet and

Petit (2002)]; *N. quasilla* (Petit, 1987), new combination [described in *Cancellaria*], *N. kastoroae* (Verheeken, 1997) new combination, and *N. suduirauti* (Verheeken, 1999) new combination [the last two described in *Axelella*].

The fossil record has not been completely searched for *Nipponaphera* but we have recognized *Cancellaria chinensis* MacNeil, 1961 of the Okinawa Pliocene and *C. yonabaruensis* MacNeil, 1961 of the Okinawa Miocene as belonging here. Also, Oyama, Hirose and Nishimoto (1995) described the new species *Nipponaphera taguchii* from the Miocene of Japan and at the same time transferred *Cancellaria sendoi* Hatai, 1941, to the genus *Nipponaphera*.

Nipponaphera nodosivaricosa (Petuch, 1979) (Figures 26–29)

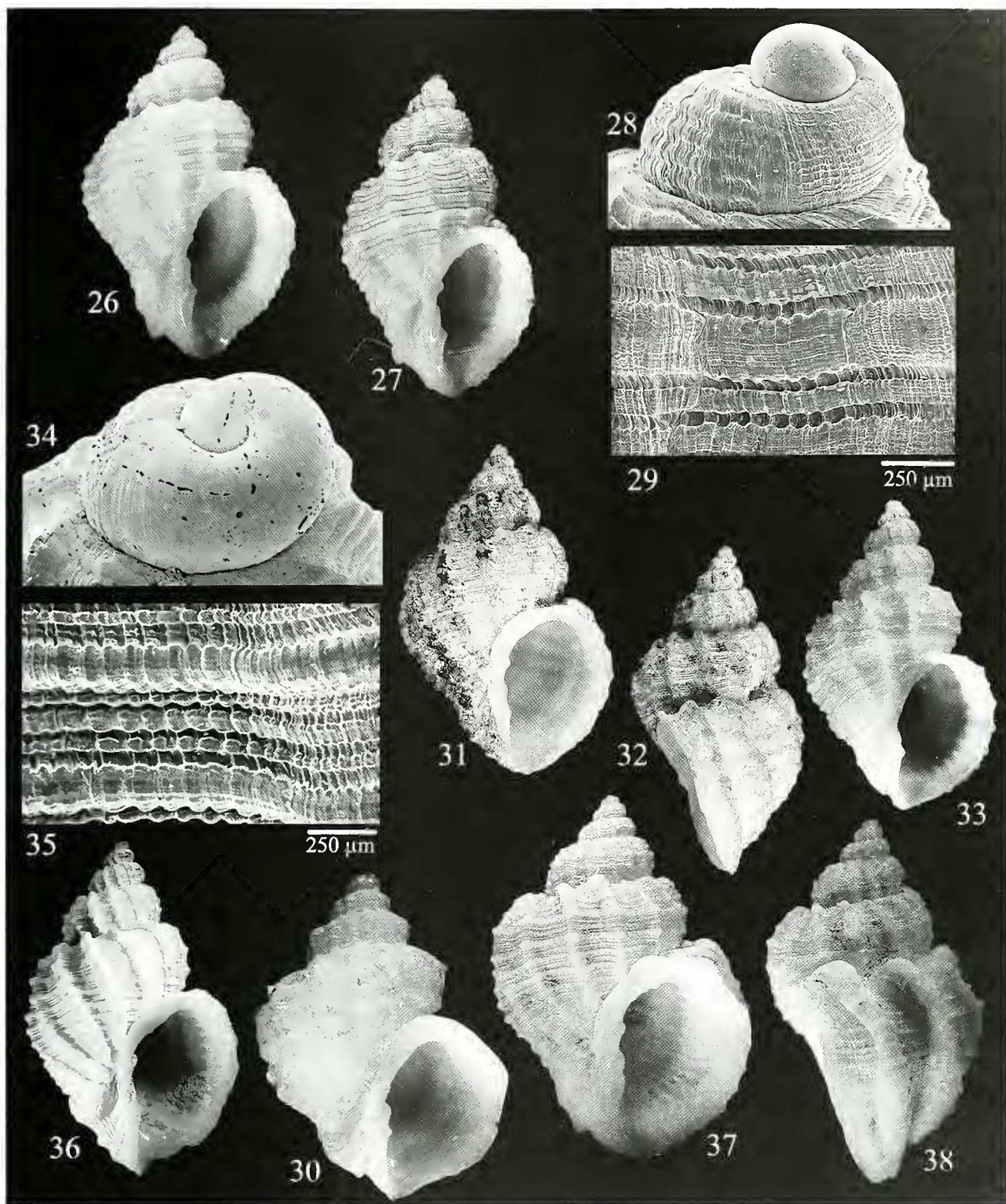
Agatrix (*Olssonella*) *nodosivaricosa* Petuch, 1979: 11, figs. 26, 27.

Description: Protoconch pale brown, of about one to 1.2 whorls with fine spiral sculpture on final third. Transition to teleoconch marked by prominent axial rib followed by onset of wide, rounded spiral cords and weak, poorly defined axial ribs. Teleoconch of 3.5 to 4.2 rounded whorls. Spiral sculpture of 12 to 15 rounded primary spiral cords, with weaker secondary cords in each interspace; about six primary cords on penultimate whorl. Primary and secondary cords all bear extremely fine spiral threads. Axial sculpture of eight to 12 prominent, elevated ribs on last whorl, more numerous on earlier whorls; final one or two ribs becoming wider, forming varices. Spiral cords and interspaces crossed by fine, closely spaced growth lines, giving surface a linen-like appearance under low magnification. Suture impressed, sutural ramp convex. Aperture elongate, rounded. Last whorl slightly constricted behind siphonal fasciole. Outer lip only slightly prosocline, edge thin. Interior of outer lip with ten to 14 strong lirations extending deeply into aperture. Stromboid notch manifested by very slight indentation in outer lip. No parietal callus; some specimens with a thin wash on parietal area. Inductural area covered with thin callus, which extends back over chink-like umbilicus. Columella with three folds, posterior one most prominent, almost perpendicular to axis; two anterior folds sharply descending, situated on ends of u-shaped platform, anterior-most one forming edge of short but well-defined siphonal canal. Exterior cream to pale yellow-brown, many specimens with irregular markings; most specimens with two or three white spiral cords at periphery of last whorl, with two or three dark brown cords above and below.

Type Material: Holotype (11 × 9 mm, *vide* Petuch; 12.9 × 8.2 mm, *vide* Verheeken), DMNH 126397.

Type Locality: Off Balicasag Island, Philippines, from 300 m depth.

Material Examined: New Caledonia, BATHUS 1; sta. DW672, 20°48' S, 165°21' E, 347–366 m, 1 k (Fig-



Figures 26–35. *Nipponaphera*. **26–29.** *Nipponaphera nodosivaricosa* (Petuch, 1979). **26.** Height 16.9 mm, New Caledonia, 20°17' S, 163°50' E, 500–600 m [BATHUS 4 sta. DW898]. **27.** Height 17.0 mm, New Caledonia, 20°48' S, 165°21' E, 347–366 m [BATHUS 1 sta. DW672]. **28.** Protoconch, 21°45' S, 166°37' E, 250 m [BATHUS 1 sta. CP713]. **29.** Teleoconch microsculpture, same specimen as 28, same scale. **30.** *Nipponaphera argo* new species, holotype, height 8.6 mm; Coral Sea, 22°48' S, 159°24' E, 450 m [MUSORSTOM 5 sta. 300]. **31–36.** *Nipponaphera agastor* new species, holotype, height 19.3 mm, Solomon Islands, 9°21' S, 160°24' E, 357–359 m [SOLOMON I sta. CP1800]. **33.** Height 12.4 mm, Fiji, 19°52' S, 174°40' W, 383–393 m [BORDAU 1 sta. CP1561]. **34.** protoconch, Vanuatu, 20°20' S, 169°49' E, 400–440 m [MUSORSTOM 5 sta. CP963]. **35.** Teleoconch microsculpture; same specimen as 34, same scale. **36.** Height 17.9 mm, Philippines, 11°01' N, 124°04' E, 214–246 m [MUSORSTOM 3 sta. CP145]. **37–38.** *Nipponaphera tuba* new species, holotype, height 20.7 mm, Vanuatu, 15°10' S, 167°14' E, 394–421 m [MUSORSTOM 5 sta. CP1057].

ure 27), 1 dd.—Sta. CP713, 21°45' S, 166°37' E, 250 m, 1 lv (Figures 28–29). BATHUS 2: sta. DW717, 22°44' S, 167°17' E, 350–393 m, 1 lv. BATHUS 4: sta. CP897, 20°16' S, 163°52' E, 305–350 m, 1 lv.—Sta. DW898, 20°17' S, 163°50' E, 500–600 m, 1 dd (Figure. 26).—Sta. DW901, 19°03' S, 163°15' E, 297 m, 1 dd.—Sta. CP905, 19°02' S, 163°16' E, 294–296 m, 1 lv.—Solomon Islands. SOLOMON 1: sta. CP1801, 9°25' S, 160°26' E, 264–273m, 1 lv. (Dimensions of largest New Caledonia specimen: 18.5 × 11.6 mm.)

Distribution: At this time *Nipponaphera nodosivaricosa* is known only from New Caledonia, the Solomons and the Philippines (Springsteen and Leobrero, 1986; Verhecken, 1999). The Indonesian specimen figured as *Axellella* cf. *nodosivaricosa* by Verhecken (1997: 299, figs. 5–7) was not attributed by him in his 1999 work to either *N. nodosivaricosa* or *N. suduirauti* (see below). In the New Caledonian dredgings, live specimens were taken from depths of 250–393 m and empty shells from as deep as 600 m.

Remarks: Verhecken (1999) described the species *Axellella suduirauti*, here placed in *Nipponaphera*, distinguished from *N. nodosivaricosa* based on protoconch characteristics. It was stated that *N. suduirauti* has a multispiral protoconch as opposed to the paucispiral protoconch of *N. nodosivaricosa*. Our specimen of *N. nodosivaricosa* from the Solomon Islands has a protoconch that is difficult to attribute to one or the other of the two species and we believe that the separation between *N. nodosivaricosa* and *N. suduirauti* should be reevaluated, perhaps using molecular characters. We refer to Verhecken's (1999) work for his discussion on the question.

Nipponaphera argo new species
(Figure 30)

Description: Protoconch smooth, of 1.1 whorls, diameter 1050 μm. Teleoconch of about 3.1 whorls, high-spired. Whorl profile angulated at shoulder. Sculpture of low, broad axial ribs and much finer spiral cords of rather even strength, except for one on sutural ramp and two at periphery of last whorl, which are more prominent than others; 14 axial ribs on penultimate whorl, seven on last whorl (specimen with severe growth scar and regrowth, distorting sculpture of last whorl); about 15 spiral cords on penultimate whorl and about 35 on last whorl, crossed by thin incremental riblets. Suture shallowly impressed. Last whorl slightly constricted behind siphonal fasciole. Outer lip thin, sharp, smooth within, lacking lirae. Inner lip with well-developed parietal shield, extending slightly over narrow umbilicus. Columella only slightly concave, with three folds; anterior two close together, much like one large bifurcate fold. Siphonal canal short, indistinct. Exterior uniformly very pale yellowish-white.

Type material: Holotype MNHN 20511 (8.6 × 6.5 mm) and one paratype MNHN 20512.

Type Locality: Argo Bank, Coral Sea, 22°48' S, 159°24' E, 450 m [MUSORSTOM 5, sta. 300].

Material Examined: Coral Sea. MUSORSTOM 5, sta. 299, 22°48' S, 159°24' E, 360–390 m, 1 dd (paratype).—Sta. 300, 22°48' S, 159°24' E, 450 m, 1 dd (holotype, Figure 30).

Etymology: Named for the Argo Seamount, a prominent topographic feature of the Coral Sea, from which the specimens were collected; to be treated as a noun in apposition.

Distribution: Coral Sea (Argo Seamount), dead in 390–450 m.

Remarks: *Nipponaphera argo* differs from *N. goniata* Bouchet and Petit, 2002 by its sculpture of broad, low, non-lamellar axial ribs. Also, the spiral cords of *N. argo* are of more even strength, except for one on the shoulder and two on the periphery, which imparts a slightly biangular aspect to shells of this species.

Nipponaphera agastor new species
(Figures 31–36)

Description: Protoconch normally smooth, corroded on holotype, of 0.9 whorls, diameter 800 μm. Protoconch/teleoconch boundary indistinct due to corrosion, but distinctly marked by onset of teleoconch sculpture on specimens from Vanuatu. Teleoconch of five rounded whorls; spire angle 64°; suture deeply impressed. Axial sculpture of prominent, regularly spaced ribs, eleven on last whorl, eleven on penultimate whorl. Ribs rounded over steep, narrow sutural ramp. Spiral sculpture of evenly spaced, prominent spiral cords, eight on penultimate whorl, 13 on last whorl, with three to five secondary cords in each interspace; spiral cords rise over axial ribs, forming small nodules on primary cords at intersections. Numerous fine growth lines cross spiral cords, creating small imbrications. Last whorl slightly constricted behind siphonal fasciole. Outer lip prosocline. Inner margin of lip smooth apart from 16 prominent lirae extending into aperture; two indistinct lirae on parietal area. Columellar callus well developed, forming shield over chink-like umbilicus. Columella with three almost equal folds; anterior one sloping sharply down at edge of small but distinct siphonal canal, which recurves abaxially. Exterior chalky white.

Type Material: Holotype 20513 (19.3 × 12.3 mm) and 4 paratypes MNHN 20514.

Type Locality: Between Guadalcanal and Florida Island, Solomon Islands, 9°21' S, 160°24' E, 357–359 m [SOLOMON 1: sta. CP1800].

Material Examined: Vanuatu. MUSORSTOM 8: sta. CP963, 20°20' S, 169°49' E, 400–440 m, 1 lv (Figures 31–35).—Tonga. BORDAU 2: sta. CP 1561, 19°52' S, 174°40' W, 383–393 m, 1 dd (Figure 33).—Solomons. SOLOMON 1: sta. CP1746, 09°23' S, 159°57' E, 302–396 m, 1 dd; Sta. CP1800, 9°21' S, 160°24' E, 357–

359 m, 4 lv, 1 dd (holotype, Figures 31–32, and paratypes).—Philippines. MUSORSTOM 3: sta. CPI45, 11°01' N, 124°04' E, 214–246 m, 1 dd (Figure 36).—Punta Engaño, tangle nets, approximately 60 hrs, 1 spm.

Etymology: From the Greek *agastor*, a noun in apposition, meaning near kinsman or brother, to highlight the similarity to *N. nodosivaricosa*.

Distribution: Only known from the material examined: Philippines, Solomons, Vanuatu and Tonga. Depth range in the southwest Pacific 360–400 m; in the Philippines possibly shallower.

Remarks: Specimens from the Philippines and the Solomons are distinctly larger with adult sizes ranging from 16.8 mm to 19.5 mm, whereas specimens from Vanuatu and Tonga are much smaller with adult sizes at 12.2 mm and 12.3 mm respectively.

Nipponaphera agastor is sympatric with *N. nodosivaricosa* in the Philippines and the Solomon Islands but differs by its spiral sculpture with more numerous (3 to 5) secondary cords, not separated by an incised groove as in *N. nodosivaricosa*. It differs from *N. tuba*, with which it is sympatric in Vanuatu, by being more slender and lacking a stromboid notch.

Nipponaphera tuba new species
(Figures 37–38)

Description: Protoconch smooth, of 0.9 whorls, diameter 500 μm . Protoconch/teleoconch boundary distinctly marked by onset of teleoconch sculpture. Teleoconch of five rounded whorls; spire angle 75°; suture deeply impressed. Axial sculpture of prominent, regularly spaced ribs, ten on last whorl, 14 on penultimate whorl; ribs rounded on steep, narrow sutural ramp. Spiral sculpture of evenly spaced cords of several strengths; primary cords evenly separated by one secondary cord, resulting interspaces filled with two or three tertiary cords; spiral cords rising over axial ribs, forming small nodules on primary spiral cords at intersections. Numerous fine growth lines cross spiral cords, creating small imbrications. Last whorl slightly constricted behind siphonal fasciole. Outer lip prosocline, with distinct stromboid notch adapical to center of lip. Inner margin of lip smooth or slightly crenulate, with 19 prominent lirae extending into aperture, four additional lirae beneath sutural ramp. Columellar callus well developed, forming shield over chink-like umbilicus. Columella with three almost equal folds, anterior one sloping sharply down at edge of small but distinct siphonal canal, which recurves abaxially. Exterior yellow-brown with a band of white below periphery, bordered by indistinct bands of darker brown.

Type Material: Holotype MNHN 20516 (20.7 \times 15.0 mm) and one paratype MNHN 20517.

Type Locality: Vanuatu, 15°10' S, 167°14' E, 394–421 m [MUSORSTOM S: sta. CPI057].

Material Examined: Vanuatu, MUSORSTOM S: sta. CPI057, 15°10' S, 167°14' E, 394–421 m, 1 lv, 1 dd

(holotype, Figures 37–38, and paratype).—Sta. [no data, mixed lot], 1 dd.

Etymology: From the Latin *tuba*, a war trumpet, which this new species can, with some imagination, be reminiscent of; used as a noun in apposition.

Distribution: Known only from Vanuatu.

Remarks: *Nipponaphera tuba* differs from *N. cyphoma* Bouchet and Petit, 2002 in being more rounded and robust. Also, the spiral sculpture never appears as incised lines as in *N. cyphoma* and *N. nodosivaricosa*. *Nipponaphera tuba* also has a thick outer lip that is not present in *N. cyphoma*.

Genus *Trigonostoma* Blainville, 1827

Trigona Perry, 1811: pl. 51. Type species: *Trigona pellucida* Perry, 1811, by monotypy. Not *Trigona* Jurine, 1807 (Hymenoptera).

Trigonostoma Blainville, 1827: 632. Type species: *Delphinula trigonostoma* Lamarek, 1822 (?= *Buccinum scalare* Gmelin, 1791), by monotypy. Recent, Indo-Pacific.

Remarks: *Trigonostoma* has a different taxonomic composition for various authors. We here use *Trigonostoma sensu lato* to encompass the nominal genera *Venturia* Jousseaume, 1887, *Arizelostoma* Iredale, 1936, *Ovilia* Jousseaume, 1887, and *Extractrix* Korobkov, 1955. We do not include *Scalptia* Jousseaume, 1887, *Trigonaphera* Iredale, 1936 and *Cancellaphera* Iredale, 1930, which are sometimes treated as subgenera of *Trigonostoma*.

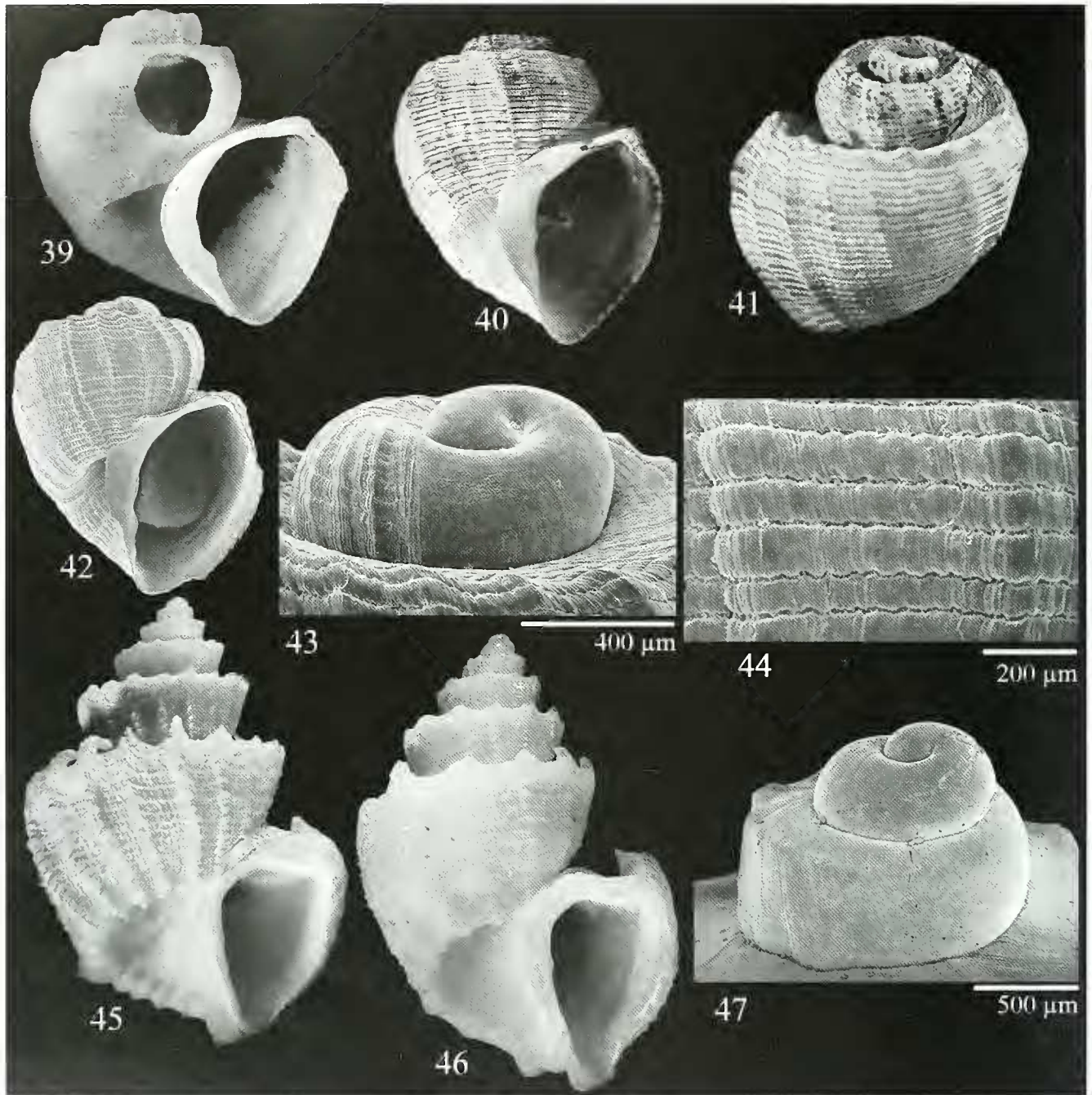
Trigonostoma tryblium new species
(Figures 39–44)

Description: Protoconch smooth, glassy, of one whorl, diameter 1050 μm . Transition from protoconch to teleoconch abrupt, denoted by onset of axial and spiral sculpture. Teleoconch of 2.5 whorls; spire depressed; umbilicus broad. First teleoconch whorl with 16 axial ribs. Second whorl with about 18 axial ribs that have become somewhat obsolete. Spiral sculpture of broad, closely spaced cords with narrow interspaces; about seven to ten spiral cords on sutural ramp and 25 between shoulder angle and umbilical rim. Sutural ramp weakly concave, but forming deeply channeled shoulder between shoulder angle and impressed suture. Aperture narrowly ovate. Outer lip smooth. Inner lip forming parietal shield, partly covering deep, wide umbilicus. Columella with two descending folds. Anterior canal not constricted. Holotype exterior chalky white, with two broad, ill-defined brown bands, best seen through shell.

Type Material: Holotype MNHN 20518 (7.0 \times 6.5 mm).

Type Locality: North of Makira Island, Solomon Islands, 10°13' S, 161°29' E, 381–383 m [SOLOMON I: sta. CPI837].

Material Examined: Taiwan, TAIWAN 2000, sta. DW36, 21°54.8 N, 120°36.2 E, 305 m, Bashii Channel, 1



Figures 39–47. *Trigonostoma*. 39–44. *Trigonostoma tryblium* new species. 39. Height 8.3 mm, Taiwan, Bashi Channel, 21°54.8' N, 120°36.2' E, 305 m [TAIWAN 2000 sta. DW36]. 40–41. Holotype, height 7.0 mm, Solomon Islands, 10°13' S, 161°29' E, 351–383 m [SOLOMON 1 sta. CP1837]. 42. Height 5.0 mm; New Caledonia, 23°03' S, 166°58' E, 397–400 m [BATHUS 2, sta. DW730]. 43–44. Protoconch and teleoconch microsculpture, same specimen as 42. 45–47. *Trigonostoma thysthlon* Petit and Harasewych, 1987. 45. Height 16.9 mm, New Caledonia, 22°47' S, 167°28' E, 241–245 m [BATHUS 2 sta. CP728]. 46. Height 15.0 mm, Fiji, 16°50.4' S, 175°12.5' E, 200–215 m [MUSORSTOM 10; sta. DW1333]. 47. Protoconch, New Caledonia, 22°43' S, 167°16' E, 300 m [SMIB 1 sta. DW6].

dd (Figure 39). SOLOMONS. SOLOMON 1: sta. CP1837, 10°13' S, 161°29' E, 351–383 m, 1 lv (holotype, Figures 40–41). NEW CALEDONIA. BIOCAL Sta. DW77, 22°15' S, 167°15' E, 440 m, 1 juv. lv.—BATHUS 2, sta. DW730, 23°03' S, 166°58' E, 397–400 m, 1 juv. dd (Figures 42–44).

Etymology: From the Latin *tryblium*, meaning cup, a shape that the new species is somewhat reminiscent of; used as a noun in apposition.

Distribution: Known only from Taiwan, New Cale-

donia and the Solomons. Alive in 353–440 m; empty shells from 305 m.

Remarks: Of the known Recent species of *Trigonostoma*, *Trigonostoma tryblium* resembles only *T. semidisjuncta* (Sowerby, 1849) in having primarily spiral sculpture. It differs from that species in being more depressed, with a broader umbilicus. In *T. semidisjuncta* there is no spiral sculpture on the sutural ramp. Also, the spiral sculpture of *T. semidisjuncta* is arranged in groups of cords separated by wide furrows.

Trigonostoma thysthlon Petit and Harasewych, 1987
(Figures 45–47)

Trigonostoma thysthlon Petit and Harasewych, 1987: 79, figs. 5, 8–13.

Trigonostoma antiquata—Habe, 1961a: 435, pl. 24, fig. 14; pl. 23, fig. 5; 1961b: 73, pl. 36, fig. 8; Lan, 1979: 95, pl. 41, figs. 93, 93a; Abbott and Dance, 1982: 299 (second figure in bottom row); Habe and Okutani, 1985: 233 (second figure in bottom row); Bosch, et al., 1995: 157, fig. 657. [not *Cancellaria antiquata* Hinds, 1843]

Trigonostoma antiquatum—Oyama and Takemura, 1963: *Trigonaphera* (2) plate, fig. 5. [not *Cancellaria antiquata* Hinds, 1843]

Trigonostoma (sic) thysthlon—Hasegawa, 2000: 581, pl. 290, fig. 11.

Type Material: Holotype, USNM 747301 (17.3 × 12.7 mm).

Type Locality: Off west coast of Wasir Island, West Wokam, Aru, Moluccas (5°30' S, 134°12' E) in 56–73 m.

Material Examined: New Caledonia. LAGON: sta. 357, 22°39' S, 167°07' E, 225 m, 1 dd.—SMHB 1: sta. DW6, 22°43' S, 167°16' E, 300 m, 1 dd (Figure 47).—BATHUS 2: sta. CP728, 22°47' S, 167°28' E, 241–245 m, 1 lv (Figure 45).—Dredged at “300–400 m”, off Belep, north New Caledonia, 1 spm. Fiji. MUSORSTOM 10: sta. DW1333, 16°50.4' S, 178°12.5' E, 200–215 m, 1 dd (Figure 46). Solomons. SOLOMON 1: sta. DW1850, 10°28' S, 161°59' E, 139–261 m, 1 lv.

Description (of a specimen from New Caledonia): Protoconch smooth, glassy, of 1.8 whorls, diameter 1050 µm. Transition to teleoconch marked by axial rib followed by both axial and spiral sculpture and flattening of the sutural ramp. Teleoconch of up to six tabulate whorls. Sutural ramp flat, bordered by cord-like shoulder angle. Suture impressed. Axial ribs prominent, extending from suture across ramp, over shoulder angle, where they form recurved spines on many specimens, down and over siphonal fasciole, then inside umbilicus. Shoulder spines not formed on all ribs, but many ribs lacking spines form short, sloping buttress against preceding whorl; about 12–15 ribs on last whorl, more numerous on earlier whorls; two thick, closely spaced ribs mark end of growth in adults; a few varix-like rib occurs earlier on some specimens. Fine, closely packed growth lines of varying number in axial interspaces slightly overlap each other, producing a scabrous appearance. Spiral

sculpture of very closely spaced cords, rising over ribs to form small nodes. Sutural ramp with about 12–15 spiral cords of uniform prominence; about 15 primary spiral cords on last whorl between shoulder angle and siphonal fasciole; about ten fine secondary cords in each interspace. Spiral cords of equal strength continue inside umbilicus. Outer lip slightly prosocline. Outer lip thickened by varix, slightly serrate on margin, interior with eight to ten short irregular lirae, not extending quite to outer edge of lip and not extending deeply into aperture. Aperture triangular, with small posterior notch under sutural ramp. Posterior portion of inner lip adpressed against siphonal fasciole and anterior quarter of penultimate whorl. Inner lip with two descending folds, posterior one slightly larger than anterior; third incipient fold present in some specimens. Umbilicus extends to protoconch. Siphonal canal short. Exterior white with very faint orange-brown at shoulder. Specimens over 24 mm in height are known.

Distribution: Gulf of Oman to the Moluccas, Japan, the Philippines, Solomon Islands, New Caledonia and Fiji.

Remarks: The intricate sculpture resulting from the overlap of growth lines, which is so noticeable on the New Caledonian specimens, is absent from *T. antiquatum* and is much less evident on *T. thysthlon* from other areas. However, we do not consider this difference to be of taxonomic significance. This sculpture is a prominent feature of *T. scalare* (Gmelin, 1791), the type of the genus but that species has a more angular shape and its whorls are barely attached.

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